Health Consultation

Volatile Organic Compounds in Well Water at the Lewis County Central Maintenance Shop

Chehalis
Lewis County, Washington

May 2000

Prepared by
Washington State Department of Health
under a cooperative agreement with the
Agency for Toxic Substances and Disease Registry

Foreword

The Washington State Department of Health (DOH) has prepared this health consultation in cooperation with the Agency for Toxic Substances and Disease Registry (ATSDR). ATSDR is an agency of the U.S. Department of Health and Human Services and is the principal federal public health agency responsible for health issues related to hazardous waste. This health consultation was prepared in accordance with methodologies and guidelines developed by ATSDR.

The purpose of a health consultation is to identify and prevent harmful human health effects resulting from exposure to hazardous substances in the environment. Health consultation enable DOH to respond quickly to requests from concerned residents for health information on hazardous substances and to provide advice on specific public health issues. DOH evaluates sampling data collected from a hazardous waste site, determines whether exposures have occurred or could occur, reports any potential harmful effects, and recommends actions to protect public health.

For additional information or questions regarding DOH, ATSDR, or the contents of this health consultation, please contact the preparer of this report:

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Glossary of Acronyms and Terms

EMEG: Environmental Media Evaluation Guide. A concentration of a chemical in air, soil, or water (or other environmental media) established by ATSDR. An EMEG is derived from the MRL. When chemical concentrations are below the EMEG, adverse noncancer health effects are not expected to occur. Separate EMEGs can be derived to account for different exposure durations (acute, intermediate, or chronic).

RMEG: Reference Dose Media Evaluation Guide. A concentration of a chemical in air, soil, or water (or other environmental media) established by ATSDR. A RMEG is derived from EPA's RfD. When chemical concentrations are below the RMEG, adverse noncancer health effects are not expected to occur. RMEGs are only used for chronic exposure.

MRL: Minimal Risk Level. A MRL is an estimate made by ATSDR of daily human exposure to a dose of chemical that is likely to be without an appreciable risk of adverse noncancerous health effects over a specified duration of exposure. MRLs are derived when reliable and sufficient data exist to identify the target organ(s) of effect, or the most sensitive health effect(s) for a specific duration via a given route of exposure. MRLs can be derived for acute, intermediate, and chronic duration exposures by the inhalation and oral routes.

CANCER SLOPE FACTOR: A plausible upperbound estimate made by EPA of the probability of a response per unit intake of a chemical over a lifetime. The slope factor is used to estimate an upperbound probability of an individual developing cancer as a result of a lifetime of exposure to a particular level of a potential carcinogen.

LOAEL: Lowest Observed Adverse Effect Level. The lowest exposure level that has been found to produce statistically or biologically significant increases in the frequency or severity of adverse health effects between the exposed population and its appropriate control group in dose-response experiments. LOAEL's are classified into "less serious" and "serious" effects.

MCL: Federal Maximum Contaminant Level. A drinking water regulation established under the Safe Drinking Water Act. The MCL of a contaminant is the maximum permissible concentration in water that is delivered to the free-flowing outlet of the ultimate user of a public water system. MCLs are enforceable standards established by EPA.

CARCINOGEN: Any substance that can cause or contribute to the production of cancer.

CONTAMINANT: Any substance or material that enters a system (the environment, human body, food, water, etc.) where it is not normally found.

MTCA: Model Toxics Control Act. Washington State's hazardous waste clean-up law.

Background and Statement of Issues

The Lewis County Central Shop (Shop) is a facility used to perform highway and vehicle maintenance. The Shop, located at 109 Forest Napavine Road in Chehalis, Washington, has been in operation since the mid-1950s, and currently employs approximately 25 people. The surrounding area is predominantly rural, with the nearest residence located within a quarter mile of the facility. The site consists of about 7 acres of paved and unpaved area. There are five buildings on the site: a facilities maintenance shop, where equipment maintenance is performed; a traffic control office/paint shop; an equipment storage shop; a bridge crew shop, and a wash building and a fueling island. Also located on the site are three aboveground storage tanks containing road oil, one underground storage tank used to store heating oil, and two underground storage tanks used to store diesel fuel and gasoline. Chlorinated solvents may have been used at the Shop in the past for vehicle and construction equipment maintenance, and for washing.

In early June 1998, as a result of a required VOC test, the Shop's system operator collected a water sample from the Shop's drinking water well. Results of this sampling indicated the presence of volatile organic compounds (VOCs). The results were reported to the Washington State Department of Health (DOH) after laboratory analysis was completed on June 9, 1998. Follow up testing of water from the Shop's drinking water well and seven nearby domestic wells was conducted by the DOH Division of Drinking Water on June 24 and July 22, 1998. Test results confirmed the presence of elevated levels of VOCs in the Shop well, and low levels of several VOCs in three nearby wells. Because results indicated that three of these nearby wells, servicing the Grange, the Tietzel's residence, and the Douglas Christmas Tree Farm have been impacted, DOH recommended follow-up testing [1].

As a result of the VOC detections in the Shop's well, signs warning employees not to drink the water were placed at various locations within the Shop facilities sometime between June 22 and July 22, 1998 [2]. Because of taste and odor problems associated with the well water, Shop employees have been provided bottled water since at least 1991 [2]. Because no sampling was conducted before 1998, the precise reason for the taste and odor problem is unknown. Employees indicated that they have not consumed water from the Shop well for approximately 20 years (i.e., many years before bottled water was supplied).

One source of the VOCs is suspected to be from Lewis County's practice of washing off vehicles at the Shop, and allowing the runoff to infiltrate into the ground [3]. In 1998, the county built a new wash station at the site for cleaning county vehicles. The new station uses a sump and filtration system to collect contaminants and reuse the water. A Washington State Department of Ecology (Ecology) inspection in 1985 found that employees were incorrectly handling hazardous waste at the site, including the practice of transporting waste paint sludge and waste solvent containing methylene chloride and toluene to the Centralia Landfill. During the inspection, Ecology noted considerable staining of the ground at the Shop where waste paint historically had been poured [4]. Ecology recently issued an Agreed Order which directs the county to prepare a Scope of Work Plan to investigate the site and implement appropriate cleanup actions.

This health consultation evaluated potential health risks, assuming that Shop employees consumed contaminated drinking water from the Shop well during a 25-year period. Because of the taste and odor problems with the well water, Shop employees indicated during a DOH site visit in September 1999, that long-term consumption of the Shop's well water did not occur. The conservative exposure assumption used in this health consultation is intended to account for employees who may have consumed the water despite its taste and odor and former employees who may have consumed the Shop's well water. Contaminant concentrations and exposure assumptions used in the health consultation are presented in Table 1 and Appendix A, respectively.

DATA SUMMARY

On June 24 and July 22, 1998, DOH collected water samples from the Lewis County Central Shop wellhead tap. The Environmental Protection Agency (EPA) method 524.2 (VOC analysis) was used for the water sample analysis.

A total of 11 VOCs were detected in the Shop well water sample. Four of the 11 detected contaminants exceeded one or more health-based comparison values and are evaluated in this health consultation. Contaminants that were detected at levels below comparison values are unlikely to pose a public health threat and will not be discussed further.

TABLE 1
CONTAMINANT CONCENTRATIONS
LEWIS COUNTY CENTRAL MAINTENANCE SHOP DRINKING WATER WELL
(JUNE 24, 1998 SAMPLING RESULTS)

Chemical/Analyte	Concentration (µg/l)	Carcinogenic Comparison Value (µg/l)	Non carcinogenic Comparison Value (µg/l)
1,1-Dichloroethylene	*19*	0.06 (CREG)	300 (adult chronic EMEG)
1,1,1-Trichloroethane	44.1	NA	200 (MCL/LTHA)
Trichloroethylene	*334*	3 (CREG)	NA
1,4-Dichlorobenzene	*124*	18.2 (MTCA B)	10,000 (adult Int. EMEG)
Cis-1,2 Dichloroethylene	15.6	NA	10,000 (adult Int. EMEG) 70 (MCL/LTHA)
Tetrachloroethylene	*334*	0.7 (CREG)	400 (adult RMEG)
Chlorobenzene	2.6	NA	700 (adult RMEG) 100 (adult LTHA)
1,2-Dichlorobenzene	276	NA	3,000 (adult RMEG) 600 (LTHA)
1,1-Dichloroethane	3.1	NA	800 (MTCA B)
o-chlorotoluene	8.9	NA	160 (MTCA B)
m-chlorotoluene☆	23.6	NA	160 (MTCA B)

µg/l = micrograms of chemical per liter of water (equals one part per billion)
CREG = ATSDR's Cancer Risk Evaluation Guide
RMEG = ATSDR's Reference Dose Media Evaluation Guide
LTHA - EPA's Lifetime Health Advisory for Drinking Water
MTCA B = Washington State Department of Ecology Model Toxics Control Act Cleanup Regulation, Method B groundwater cleanup level
MCL = Federal Safe Drinking Water Act Maximum Contaminant Level
Int. EMEG = ATSDR's Intermediate duration Environmental Media Evaluation Guide
NA = Not available
Italicized and shaded cells = compounds exceeding one or more comparison value which required further evaluation
☆ Used o-chlorotoluene as a surrogate

TABLE 2
CANCER AND NONCANCER RISKS

Chemical/Analyte	Ingestion Rate (liters/day)	Exposure Frequency (days/year)	Exposure Duration (years)	Hazard Quotient ★ (noncancer)	Increased Cancer Risk
1,1-Dichloroethylene	1	250	25	0.02	4×10^{-5}
1,1,1-Trichloroethane	1	250	25		
Trichloroethylene	1	250	25	0.016	1×10^{-5}
1,4-Dichlorobenzene	1	250	25	0.003	1×10^{-5}
cis-1,2 Dichloroethylene	1	250	25	0.0005	
Tetrachloroethylene	1	250	25	0.3	6×10^{-5}
Chlorobenzene	1	250	25	0.001	
1,2-Dichlorobenzene	1	250	25	0.03	
1,1-Dichloroethane	1	250	25	0.0003	
o-chlorotoluene	1	250	25	0.004	
m-chlorotoluene☆	1	250	25	0.012	
				Total = 0.39	Total = 1.2×10^{-4}

★ Hazard Quotient less than 1 indicates that non cancer health risks are unlikely to result from exposure

Discussion

ATSDR, as well as other agencies, has developed health-based comparison values for chemicals in various environmental media, including water. These define the concentration at or below which carcinogenic and/or noncarcinogenic health effects are not likely to result following exposure. Contaminant concentrations exceeding these values do not *necessarily* pose a health threat, but have been further evaluated to determine the potential for health effects. As some VOCs in the Shop well exceeded one or more comparison values, they were further evaluated to determine whether health effects are likely. Exposures were assumed to have occurred 5 days per week, 50 weeks per year, for 25 years. Except for incidental exposures through volatilization of chemicals during certain activities (such as hand washing, cleaning, or cooking), contaminant exposures were effectively eliminated after 1991, when bottled water was first provided. The June 24, 1998, DOH sampling data were evaluated (Table 1).

Evaluating Non-cancer Risk

To evaluate potential noncancer health effects, estimated exposure doses were compared to EPA's Oral Reference Dose (RfD) or ATSDR's Minimal Risk Level (MRL). RfDs and MRLs are estimates of daily exposure of a human to a chemical that is not likely to have an appreciable non-cancer risk over a specified exposure duration. RfDs and MRLs are derived from toxic effect levels obtained from human and laboratory animal studies. The toxic effect levels are expressed as either the lowest observed adverse effect level (LOAEL) or the no-observed adverse effect level (NOAEL). In human or animal studies, the LOAEL is the lowest dose at which an adverse effect is seen, while the NOAEL is the highest dose that did not result in any adverse health effects.

To account for uncertainty (i.e., intraspecies variability, interspecies variability, and extrapolation of a subchronic effect level to its chronic equivalent), the toxic effect levels are divided by safety factors (typically from 100 to 1,000) to provide the more protective RfD or MRL. If a dose exceeds the RfD or MRL, the *potential* exists for adverse health effects. Thus, a dose only slightly exceeding the RfD or MRL is usually still well below the toxic effect level. The higher the estimated dose is above the RfD or MRL, the closer it will be to the toxic effect level.

Evaluating Cancer Risk

For screening of chemicals known or expected to cause cancer, it is assumed that no "safe" level exists, and EPA cancer slope factors are used to calculate an "estimated" increased cancer risk. An exposure which results in an estimated increased cancer risk of one additional cancer in a population of 1 million persons exposed for 30 years, averaged over a 70-year lifetime, is considered an acceptable risk and is used as the comparison value. In a population of 1 million men in the United States, about one-third (333,000) would be expected to develop cancer from all causes in their lifetime. For U.S. women, the figure is about one fifth (200,000) [5]. The estimated increased cancer risk means that if those 1 million men are exposed for 30 years to this level of the chemical, 333,001 would be expected to develop cancer. For the 1 million women

exposed, 200,001 would be expected to develop cancer. Contaminants which exceeded a cancer or non-cancer comparison value are discussed below.

1,1-Dichloroethylene

1,1-Dichloroethylene (1,1-DCE) is an industrial chemical that is not found naturally in the environment. It is used to make certain plastics and flame retardant coatings for fiber and carpet backing. 1,1-DCE is a colorless liquid that evaporates quickly at room temperature [6].

Non-cancer Health Effects

No information is available on human health effects from exposure to 1,1-DCE in drinking water. Animals exposed to high levels of 1,1-DCE developed liver and kidney disease. Birth defects did not occur in the newborn of female rats that drank 1,1-DCE. The 0.009 mg/kg/day chronic-duration oral Minimal Risk Level (MRL) is based on a Lowest Observed Adverse Effects Level (LOAEL) of 9 mg/kg/day for liver effects in rats [6]. The oral reference dose (RfD) is also 0.009 mg/kg/day, and is based on the same effects in rats [7]. *The estimated daily exposure dose for persons exposed to the detected concentration of 1,1-DCE in the Shop drinking water well is forty five times lower than the MRL and RfD, suggesting that non-cancer health effects are unlikely to result from exposure.*

Cancer Effects

EPA has determined that 1,1-DCE is a Class C (possible human) carcinogen. Evidence from epidemiological studies of workers exposed to 1,1-DCE is inconclusive. Several studies evaluated the possibility that 1,1-DCE may increase the risk of cancer in animals [6]. One of these studies suggested that mice breathing 1,1-DCE for 1 year developed kidney cancer, but the particular type of mouse used may be especially sensitive to 1,1-DCE [6]. *The estimated increased cancer risk, assuming a 25-year exposure to the detected concentration of 1,1-DCE is very low; approximately four additional cancers in a population of 100,000 persons exposed.*

Trichloroethylene

Tricholoroethylene (TCE) is a nonflammable solvent that is often used in industry for metal cleaning. TCE is also found in many adhesives, paint removers, and spot removers [8]. It is a colorless liquid that is odorless at low levels (below 100 ppm). TCE is one of the more common contaminants found in groundwater at hazardous waste sites [8]. It dissolves easily in water and can readily volatilize into the air. Exposures can occur not only by drinking the water, but also through dermal contact from dishwashing, cleaning, and bathing, and through inhalation of vapors during showering, cooking, and other domestic activities.

Noncancer Health Effects

Exposure to high levels of TCE in the air can cause central nervous system effects such as dizziness and headaches. Dermal exposure to very high concentrations of TCE can cause skin rashes. Exposure to extremely high levels of TCE can cause coma and death [8]. Chronic ingestion of low concentrations of TCE may cause liver and kidney damage, nervous system effects, impaired immune functions, lung and heart effects, and impaired fetal development in pregnant women. The applicability of these effects on humans is unclear as most of the health effects observed were from animal studies [8]. The data from human studies suggest an association between TCE exposure and developmental effects. These effects may include neural tube defects, heart malformations, oral clefts, low birth weight, and increased fetal death [8]. However, TCE exposure levels in these studies were not well defined, and there may have been exposure to multiple contaminants.

ATSDR has established an acute (less than or equal to 14 days exposure) oral Minimal Risk Level (MRL) for TCE of 0.2 mg/kg/day, which is based on developmental effects observed in rats. In animal studies, the lowest amount of TCE that showed an adverse developmental health effect caused fetal heart abnormalities after a 3-month exposure period [8]. The estimated dose to Shop employees is more than sixty-five times lower than this MRL, suggesting that non-cancerous health effects are unlikely to result from exposure to the detected concentration of TCE in the Shop drinking water well.

Cancer Effects

Until 1994, TCE was classified by EPA as a possible/probable human carcinogen. This classification has been rescinded, and TCE's potential cancer effects are currently under review. The National Toxicology Program (NTP) is also currently reviewing TCE. The International Agency for Research on Cancer (IARC) has classified TCE as a probable human carcinogen. Animal studies have shown that exposure to high levels of TCE may cause liver, lung, and testicular tumors [8]. These studies should be viewed cautiously as other potentially carcinogenic compounds were present, in addition to the TCE. There is no conclusive evidence linking TCE to cancer in humans. Studies in human populations have attempted to characterize the effects of high levels of TCE on exposed workers. These studies were often limited by a small study size or the presence of multiple chemicals, which can make the interpretation of health outcomes very difficult. Studies conducted in New Jersey and Massachusetts have linked TCE in drinking water to leukemias, specifically in children. The interpretation of these studies is very controversial as other contaminants were present in the drinking water. In addition, the exposure level and duration were not well defined, and the number of participants in the studies was small.

In order to estimate a cancer risk, the former oral slope factor was used. *The estimated increased cancer risk for a person exposed to the detected TCE concentration in the Shop well is very low; approximately one additional cancer in a population of 100,000 persons exposed for 25 years.*

1,4-Dichlorobenzene

1,4-Dichlorobenzene is a manufactured chemical which has been used to make deodorant blocks,

as an insecticide on fruit, and as an agent to control mold and mildew growth on tobacco seeds, leather, and some fabrics. It is also used in the manufacturing of some resins [9].

Non-cancer Health Effects

Human exposure to very high levels of 1,4-Dichlorobenzene over a prolonged period of time may result in dizziness, headaches, and liver problems. Workers who breathed high levels (80-160 ppm) of 1,4-Dichlorobenzene have reported painful irritation of the nose and eyes. Animal studies have demonstrated that 1,4-Dichlorobenzene can affect the liver, kidneys, and blood [9].

ATSDR has derived an intermediate duration oral MRL of 0.4 mg/kg/day, which is based on a LOAEL for the absence of liver effects in rats. *The estimated daily employee exposure dose is 400 times lower than the MRL, suggesting that noncancer effects are unlikely to result from long-term exposure*.

Cancer Effects

There is no direct evidence that 1,4-Dichlorobenzene causes cancer in humans, although EPA has determined that 1,4-Dichlorobenzene is a possible human carcinogen. An NTP study concluded that 1,4-Dichlorobenzene was carcinogenic in male rats, but not in female rats [9]. The Cancer Effect Level (CEL) for renal tubular cell adenomas in male rats is 300 mg/kg/day. The CEL for hepatocellular carcinomas and hepatoblastomas in mice is 600 mg/kg/day. The oral slope factor is based on the development of liver tumors in mice. An EPA workgroup is currently reassessing 1,4 Dichlorobenzene carcinogenicity, and has therefore removed the oral slope factor. *In order to estimate an increased cancer risk, the former oral slope factor was used. The estimated increased cancer risk for a person exposed to the detected 1,4-Dichlorobenzene level in the Shop well is very low; approximately 1 additional cancer in a population of 100,000 persons exposed for 25 years.*

Tetrachloroethylene (PCE)

PCE is a manufactured compound widely used for dry cleaning fabrics and as a metal degreaser. It is also used as an intermediate in the manufacturing of other products. PCE is one of the more common contaminants found at hazardous waste sites [10]. Cancer and non-cancer toxicity is discussed below.

Non-cancer Effects

Liver and kidney damage have been observed in laboratory animal studies after exposure to high doses of PCE. Liver weight/body weight ratios were significantly higher than in the control group for animals treated with 100 mg/kg/day of PCE. At higher doses, hepatotoxic (liver) effects were observed [7,10].

Groups of 20 Sprague-Dawley rats of both sexes were administered doses much higher than the estimated exposure dose for Shop employees. Males in the high-dose group and females in the

two highest dose groups exhibited depressed body weights. Equivocal evidence of hepatotoxicity (increased liver and kidney weight/body weight ratios) were also observed at the higher doses. Relative sensitivity to humans cannot be readily established, but the RfD of 0.01 mg/kg/day is protective of the most mild effects observed in humans [diminished odor perception/decreased test scores in volunteers exposed to 100 ppm for 7 hours; roughly equivalent to 20 mg/kg/day].

The estimated daily exposure dose for Shop employees is one-third the oral RfD and more than 4,600 times below the NOAEL used to derive the RfD, suggesting that *adverse noncancer health effects are unlikely to result* from exposure. The RfD was derived from a NOAEL of 14 mg/kg/day and a LOAEL of 71 mg/kg/day, based on hepatotoxicity in mice and weight gain in rats [10].

Cancer Effects

An EPA workgroup is currently reassessing PCE carcinogenicity, and has therefore removed the oral slope factor. The reassessment was expected to be completed in fiscal year 1999 or fiscal year 2000, and is still pending. In 1987, an EPA carcinogen assessment proposed PCE as a probable human carcinogen. In light of new data, EPA reviewed findings that suggest the weight-of-evidence for PCE is on a human carcinogen/probable human carcinogen continuum. Presently, the agency has not adopted a final position on the classification of human carcinogenicity for this chemical.

Various case-control studies were evaluated for possible associations between exposure to PCE and cancer effects in human populations. Although some of these studies indicate a possible association between exposure to PCE and various cancers, including bladder cancer, kidney cancer, and leukemia, the studies had limitations which precluded definitive conclusions.

Cancer has been reported in experimental animals after oral exposure to PCE. Statistically significant increases in hepatocellular carcinomas occurred in the treated mice of both sexes. A cancer effect level (CEL) of 386 mg/kg/day was derived from a chronic mouse study. The cancer effects in this study were hepatocellular carcinomas [10]. The estimated exposure dose is more than 120,000 times lower than this CEL. In order to estimate the cancer risk from exposure to PCE, the former oral slope factor was used. *The estimated increased cancer risk from exposure to the detected concentration of PCE is very low; approximately 6 additional cancers in a population of 100,000 persons exposed for 25 years.*

Total Cancer Risk

Carcinogenic risks from exposure to the four contaminants of concern in the Shop well were added to derive an estimated total increased cancer risk. **The total estimated increased lifetime cancer risk from exposure to the four contaminants of concern detected in the Shop well is low; approximately one additional cancer in a population of 10,000 persons exposed for 25 years**. The increased cancer risk is in addition to the expected cancer incidence rate for the general U.S. population noted previously.

Another way of expressing the increased cancer risk as it relates to Shop employee's exposures is that in a population of 10,000 persons exposed for 25 years to the four contaminants of concern detected in the Shop well, 3,334 would be expected to develop cancer (3,333 cancers normally expected during an individual's lifetime, plus one additional cancer as a result of the VOC exposures). Since the population of concern (i.e., Shop employees) is so low compared to this number (10,000), one would not expect to find any additional cases of cancer as a result of employee exposures to the carcinogenic contaminants detected in the Shop drinking water. In other words, less than one person out of 25 exposed would be expected to develop cancer.

Child Health and Developmental Effects

Because all Shop employees who were exposed were assumed to be adult males, DOH did not evaluate the potential for child health or developmental effects.

Conclusions

1. The health risk to Shop employees from ingestion of contaminated drinking water has been eliminated since the first use of bottled drinking water in 1991. Incidental VOC exposure could occur during hand washing or cleaning activities, but the exposures would be minimal and would not be expected to result in adverse health effects.

2. A low increased cancer risk would exist for persons who drank the contaminated Shop well water over many years.

3. Drinking the contaminated Shop well water over many years would not be expected to result in noncancerous health effects.

4. No apparent public health hazard currently exists as a result of VOCs in the Shop well. The no apparent public health hazard category is used for sites where human exposure to contaminated media (i.e., water) is occurring or has occurred in the past, but the exposure is below a level of health hazard**.**

Recommendations and Public Health Action Plan

Recommendations

1. Employees should not consume water from the Shop well until contaminant concentrations

are reduced, or until water treatment or an alternate water supply is provided.

Actions Taken

Signs warning employees not to drink the water were placed inside the Shop facilities following the discovery of contaminants in Shop well water in the summer of 1998. Bottled water has been provided to Shop employees since at least 1991.

2. In order to eliminate incidental and accidental exposures to contaminants in the Shop well, and to help assure a permanent, safe drinking water supply, the Shop should connect to a regulated water source, such as the Chehalis municipal water system.

Actions Planned

A city of Chehalis municipal water line is located under the road next to the Shop. The Shop plans to connect to this line after facility remodeling is completed (Personal communication with Shop employee, May 2000). Chehalis municipal water is also available to some area residences downgradient of the facility.

3. Because previous DOH well test results indicated that three nearby domestic wells (the Grange, Tietzel, and Douglas Christmas Tree Farm wells) have also been impacted, DOH recommends follow up testing for these wells. Test results should be provided to DOH for evaluation.

Actions Taken and Planned

In April 2000, DOH collected water samples from area downgradient domestic wells. Results of all sampling analysis will be provided to DOH Site Assessment section for evaluation in a separate health consultation.

4. Copies of the final health consultation report should be made available to current and former Shop employees and area residents.

Actions Planned

Copies of this health consultation will be made available to the Shop, Lewis County, Ecology, and area residents. A fact sheet summarizing the findings of this health consultation also may be prepared. Other information, such as water test results, chemical fact sheets, and inspection reports are also available at the Shop for review.

5. DOH and Lewis County should meet with Shop employees to discuss the health consultation, provide health effects information, and respond to questions or concerns they may have.

Actions Taken and Planned

DOH and Lewis County met with Shop employees in September 1999 to discuss the Shop well contamination and draft health consultation findings. Upon request, DOH offered to return to the Shop after release of the final health consultation to respond to remaining questions or health concerns.

6. DOH is available to provide additional assistance should health issues arise during the site investigation and cleanup.

Actions Taken and planned

DOH has, and will continue, to work closely with Ecology and Lewis County during site investigation and cleanup activities.

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Appendix a - Exposure Assumptions

Exposure duration
5 days/week
50 weeks/year
25 years

Ingestion rate
1 liter/day

Body weight
70 kg

Averaging time
70 years [25,550 days] (Carcinogenic)
25 years [9,125 days] (Noncarcinogenic)

APPENDIX B - EXPOSURE FORMULAS

Exposure dose = [(C x IR x EF x ED)/BW x AT)]

Additional estimated lifetime cancer risk = Estimated exposure dose x OSF

where:
C = Concentration of contaminant (mg/L)
IR = Ingestion rate (liters of water/day)
EF = Exposure frequency (days/year)
ED = Exposure duration (total # of years in exposure period)
BW = Body weight
AT = Averaging time (70 years x 365 days/year) for cancer
OSF = Oral cancer slope factor (an estimate of the excess upperbound lifetime probability of an individual developing cancer from an exposure)

References

1. Letter (September 8, 1998) from Belle Fuchs, Washington State Department of Health, to Sue Kennedy, Lewis County Environmental Health, concerning test results for VOCs detected in water samples collected from the Lewis County Central Shop well on June 24, 1998.

2. Various personal communications with Ellen Dodds, Lewis County, January 1999 - present.

3. Newspaper article. Lewis County Cleanup of Groundwater Contamination at the Lewis County Central Shop, Centralia (WA) Chronicle; August 10, 1999.

4. Washington State Department of Ecology. Resource Conservation and Recovery Act Inspection Report. May 24, 1985.

5. American Cancer Society. Facts and Figures, 1998 Cancer statistics.

6. Agency for Toxic Substances and Disease Registry (ATSDR). Toxicological Profile for 1,1-Dichloroethene, U.S. Department of Health and Human Services, Public Health Service, 1993 Update.

7. United States Environmental Protection Agency Integrated Risk Information System (IRIS), August 1999.

8. Agency for Toxic Substances and Disease Registry (ATSDR). Toxicological Profile for Trichloroethylene, U.S. Department of Health and Human Services, Public Health Service, 1997 Update.

9. Agency for Toxic Substances and Disease Registry (ATSDR). Toxicological Profile for 1,4-Dichlorobenzene, U.S. Department of Health and Human Services, Public Health Service, December 1998.

10. Agency for Toxic Substances and Disease Registry (ATSDR). Toxicological Profile for Tetrachloroethylene, U.S. Department of Health and Human Services, Public Health Service, 1997 Update.

11. Memo from Belle Fuchs, Washington State Department of Health, to Marv Coleman, Washington State Department of Ecology, concerning test results for water samples collected from the Lewis County Central Maintenance Shop well, February 10, 1999.

12. Volatile Organic Chemicals (VOCs) Analysis Report for the Lewis County Central Shop Wellhead Tap sample, July 8, 1998.

13. Various personal communications with Belle Fuchs, Washington State Department of Health, January 1999 - present.

14. DOH site visit and meeting with Lewis County Central Shop employees, September 22, 1999.

15. Agency for Toxic Substances and Disease Registry (ATSDR). ATSDR Health-Based Comparison Values. Atlanta: U.S. Department of Health and Human Services; June 1999 update.

CERTIFICATION

This Volatile Organic Compounds in Well Water at the Lewis County Central Maintenance Shop Health Consultation was prepared by the Washington Department of Health under a cooperative agreement with the Agency for Toxic Substances and Disease Registry (ATSDR). It is in accordance with approved methodology and procedures existing at the time the health assessment was begun.

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The Division of Health Assessment and Consultation, ATSDR, has reviewed this public health consultation and concurs with the findings.

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